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Food Security Policy Project Research Highlights
Myanmar

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AGRICULTURAL MECHANIZATION SOUTHERN SHAN STATE

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Introduction

This research highlight presents analysis of the characteristics of agricultural mechanization in Southern Shan State, using data from the Shan Household Agricultural and Rural Economy Survey (SHARES). SHARES was implemented in June 2018 with 1562 households in nine townships of Southern Shan State.

Results on ownership of agricultural machinery are calculated using data from all farm households. Results on machine use are taken from a subsample of farms that cultivate maize or pigeon pea, and are based on data from a randomly selected 'sample parcel' on each of these farms. Our analysis addresses the extent and characteristics of agricultural mechanization, changes in machine and draft animal ownership and use, and drivers of mechanization.

Current Extent of Mechanization

Land preparation and maize threshing are highly mechanized. In Southern Shan State, machines have nearly replaced draft animals for land preparation in maize and pigeon pea farming. Around 80% of maize and pigeon pea farming households use only machines for land preparation, and half of households use tractors during planting to create furrows into which seeds are planted by hand (Figure 1).

Eighty-nine percent of maize farming households use mechanical threshers to thresh maize. In contrast, only 13% of pigeon pea farming households thresh pigeon pea using machines. Roughly 10% of maize and pigeon pea farming households use draft animals for land preparation and planting. No draft animals are used for threshing (Figure 1).

There is little mechanization of other activities associated with maize and pigeon pea production. Only 3% of households use machines for fertilizer, pesticide or herbicide application, and 5% use a machine for weeding. No households make use of machines for harvesting maize, and mechanized seeding with tractor attachments is very rare. There is considerable scope for mechanization of these activities.

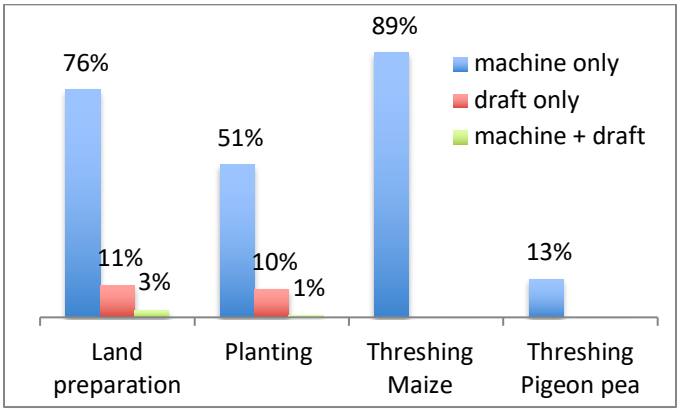

Figure 1: Share of maize and pigeon pea farming households using machinery or draft animal for maize or pigeon pea production.

Mechanization is nearly scale-neutral. Farms in all three landholding terciles have similar rates of agricultural machinery and draft animal use[1].

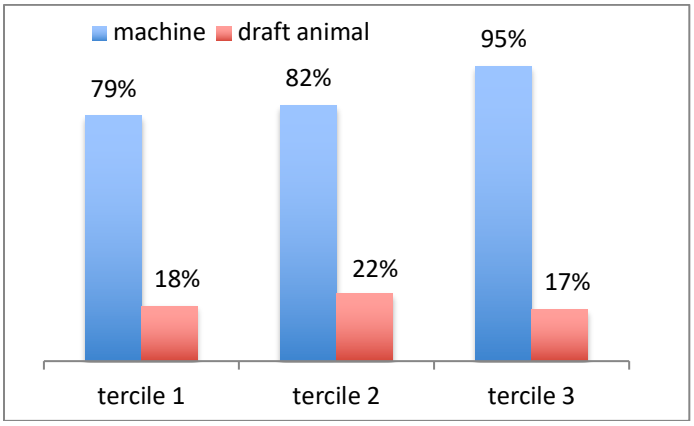

Figure 2: Share of maize and pigeon pea farming households using machinery or draft animal for any crop production task, by land tercile.

[1] Landholding terciles are created by ranking all farms according to size and dividing into three equal groups. Tercile 1 contains the third of farms with the smallest landholdings; tercile 3 the largest.

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Ninety-five percent of maize/pigeon pea farming households in land tercile 3 (those with >6 acres of land) use agricultural machinery of some kind. This falls slightly to 82% among tercile 2 households (owning 2.5-6 acre of land), and 79% for households in tercile 1 (<2.5 acre). Draft animal use varies little by farm size, occurring on around 20% of farms in all terciles (Figure 2).

Shan's hilly topography does not prevent mechanization. Machinery was used on 94% of flat parcels of land and 86% of slightly sloping parcels used to grow maize or pigeon pea. This share falls to 71% of moderately sloping and 48% of steeply sloping parcels, respectively (Figure 3). Use of draft animals is most common on moderately sloping land (29% of parcels), and similar on all other types of parcel (around 18%). However, although machine use declines with plot slope, maize and pigeon pea are rarely grown on marginal sloping land. Flat and slightly sloping land account for 43% and 46% of maize/pigeon pea parcels, respectively, while moderate and steeply sloping land account for 10% and 1%.

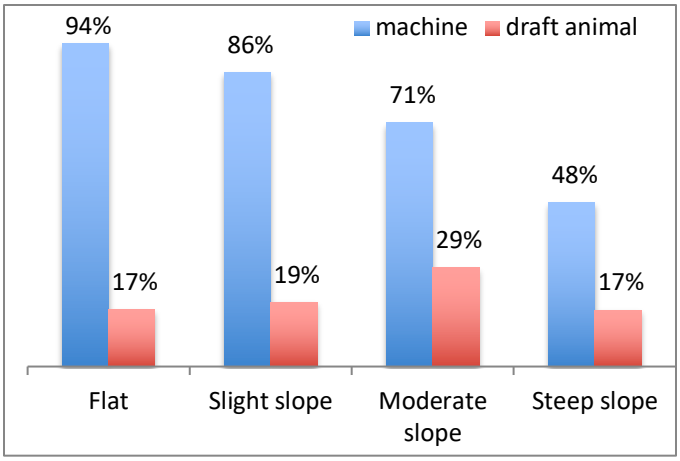

Figure 3: Share of machine and draft animal using households in maize and pigeon pea production by land topography.

Ownership and Acquisition of Agricultural Machinery

Few farmers own agricultural machinery, despite high levels of use. Two-wheel tractors (2WT) are the most common agricultural machine, owned by 22% of all farm households, followed by trawlarjee (11%). As expected, larger farmers are more likely to own machines of all kinds. Few farm households own other machines such as water pumps, reapers, threshers, or four-wheel tractors (Table 1).

Table 1: Share of farm households owning machinery (%)

	Landholding tercile			
Machines	**1**	**2**	**3**	**All**
2 WT	6.5	17.8	48.8	22.1
Trawlarjee	4.8	7.9	22.3	10.5
Water pump	3.5	4.7	6.0	4.8
Reaper	0.8	2.4	3.8	2.1
Thresher	0.3	1.8	2.4	1.3
4 WT	0.0	0.1	2.1	0.6

Most farms access machines by renting in. Ownership of two-wheel tractors increased significantly from 2007 to 2017, but the majority of households that used them rented in (Figure 4). Almost 100% of households that made use of four-wheel tractors or maize threshers rented them in. Increases in the number of households making use of all three types of machine during this period can thus be attributed mainly to the development of the rental services market.

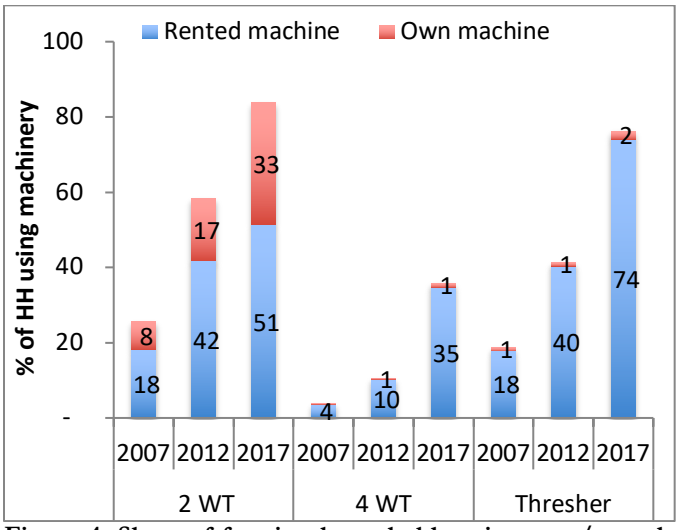

Figure 4: Share of farming households using own/rented machine in land preparation and threshing.

Machine purchases have risen year-on-year. The number of machines purchased annually grew slowly until 2007 and then began to accelerate significantly for two-wheel tractors and trawlerjee. Purchases of water pumps began to grow from 2013, while four-wheel tractors, threshers and reapers began increase from 2015-16 onwards, though the total number sold remains low (Figure 5).

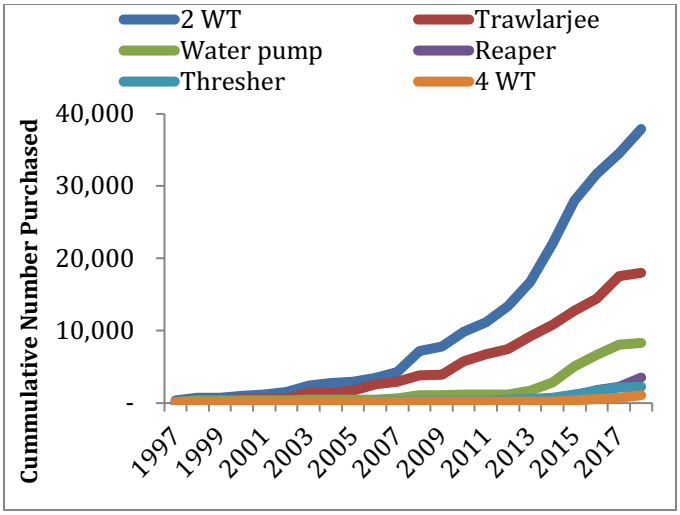

Figure 5: Cumulative purchase of different machines by year.

Most machines were purchased using cash savings. Hire purchase loans from banks and machinery suppliers became more common after 2012, especially for four-wheel tractors (Figure 6).

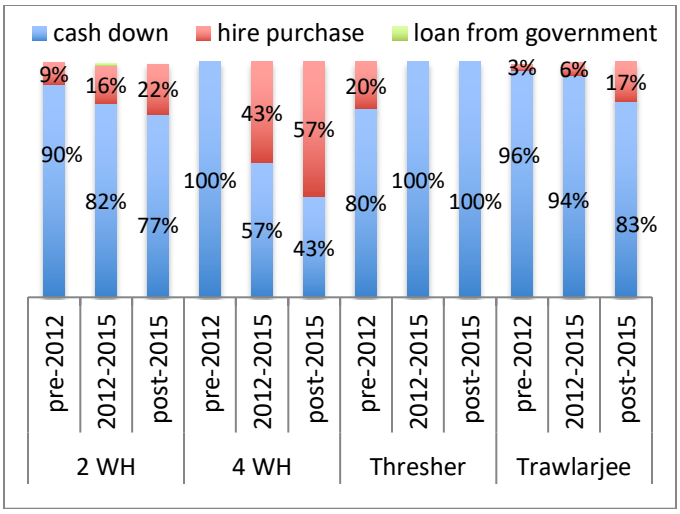

Figure 6: Source of finance over time by type of machinery.

Hire purchase accounted for 57% of four-wheel tractor sales, 22% of two-wheel tractor sales, and 17% of trawlerjee sales from 2015-2018. Farmers very rarely used loans from government sources to purchase machinery. Only 1% of farmers purchased two-wheel tractors with government loans during 2012-2015.

Declining Use of Draft Animals

Ownership of draft animals has declined sharply. Around half of all households owned draft animals at some time in the past, but only half still kept draft animals at the time of the survey. Farmers disposed of their draft animals for a variety of reasons. Insufficient labor or time to look after animals was the most common reason, cited by 25% of households. Twelve percent cited the cost or limited availability of fodder, while 14% reported owning or being able to access machinery as reasons for replacing draft power. Nineteen percent of farmers reported selling draft animals to fund productive investments, buy farmland, fund migration, or fund children's education. In 16% of cases, money from distress sales of draft animal were used to pay for home consumption or emergency expenses (Figure 7).

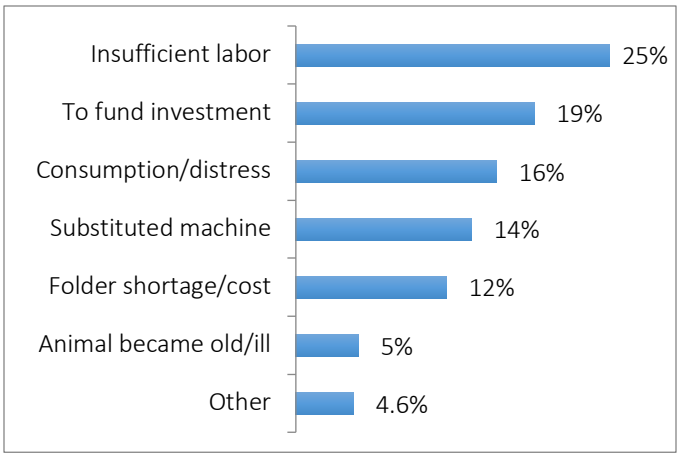

Figure 7: Main reason of farming household disposed draft animal.

Migration and acquisition of agricultural machinery are correlated with disposal of draft animals. The correlation between the year of disposal of draft animal and year of first acquisition of two- and four-wheel tractors and trawlerjee (the types of machine substituted for draft animals) is statistically significant (p=0.059). There is also a statistically significant association between year of first migration in households where any member had ever migrated and year of first acquisition of machinery (p=0.020). This suggests that direct substitution of machines for draft animals does occur, and that migration can catalyze mechanization, most likely by reducing household labor supply (Figure 8).

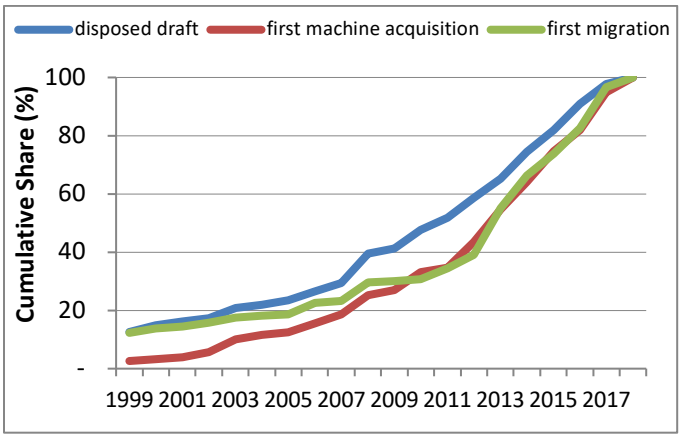

Figure 8: Cumulative share of households disposing of draft animals, acquiring machinery, and year of first migration by migrant household members, 1999-2018.

Drivers of Mechanization

Falling prices of agricultural machines have made them more accessible to farmers. The real price (adjusted for inflation) of two-wheel tractors and trawlerji declined at a fitted average rate of around 4 % per year from 2007 to 2018 (Figure 9). Imports of large volumes of low-cost machines from China have contributed to falling prices.

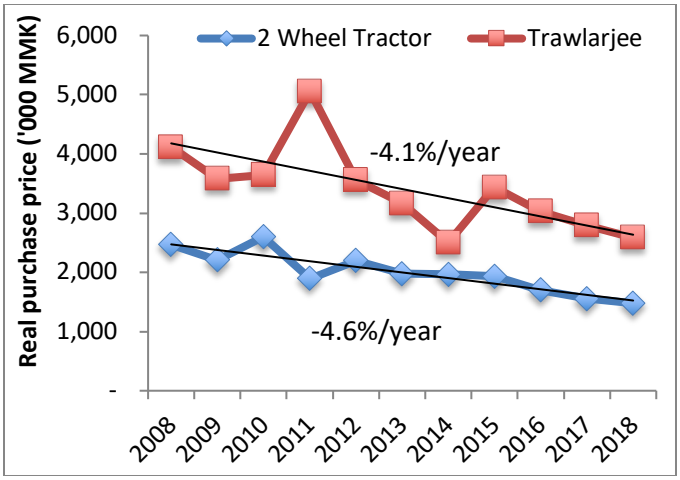

Figure 9: Purchase price of two-wheel tractors and trawlerjee (real 2017 prices).

Machines save time and money. It takes an average of 1 hour to prepare an acre of land using a four-wheel tractor or 4 hours using two-wheel tractor, whereas land preparation using draft animals takes about 12 hours per acre (Table 2). Despite the significant time saving associated with machine use the cost of renting in draft animals for land preparation is similar to that of using a four-wheel tractor (around MMK 27,000/acre) and higher than that of preparing land using a two-wheel tractor (MMK 20,000/acre).

Table 2: Average time and rental costs for machine use and draft animal in land preparation

	Time duration (Hour/Acre)	Rental charges (MMK/acre)
Draft Animal	**12.4**	**26,592**
Two Wheel	**3.9**	**19,651**
Four Wheel	**1.3**	**27,926**

Draft animals are expensive to maintain. Draft animal owning households spend an average of MMK 76,163 per year to raise these animals (MMK 48,380 on fodder; MMK 5,244 on veterinary costs, and MMK 22,539 on hired labor). Household members also spend an average of 1.5 hours per day taking care their draft animals, representing a substantial opportunity cost.

Conclusions

Rapid agricultural mechanization has taken place in Southern Shan State, accelerating especially from 2013 onwards. However, although the vast majority of farmers already use agricultural machinery for maize and pigeon pea cultivation, only land preparation, planting and threshing are highly mechanized at present. Maize harvesting remains completely non-mechanized and mechanized direct seeding is very rare. Although small combines designed for harvesting maize exist elsewhere, they are not yet widely available in Myanmar.

Growth in the use of machines is attributable in large part to the development of private rental services, which have made agricultural machinery available to farms of all sizes, resulting in remarkably even uptake.

Tractors and trawlerjees have substituted for draft animal power in land preparation and crop transport, leading to a large drop in draft animal ownership and use. This is unsurprising given the time and cost savings associated with machine use in land preparation, including the opportunity cost of time spent tending for animals. The falling real price of these machines has also attracted farmers to invest in them.

Unlike in other areas of the country, real agricultural wages have not increased much over the past five years, and thus do not appear to been a major driver of mechanization in Southern Shan – convenience, availability, and price have been more important factors.

However, migrant flows are growing, making it likely that labor will become increasingly scarce and wages will rise more rapidly in the coming years. This scenario is likely to create more demand for the mechanization of labor-intensive activities such as weeding and harvesting.

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